

**SULZER**

Sulzer Chemtech

# Mixing and Reaction Technology

Pace-setting technology, worldwide







# Contents

	Page
<b>Sulzer mixers: Broadly imitated ...never duplicated .....</b>	<b>4</b>
<b>Static mixing to your advantage .....</b>	<b>5</b>
<b>Leading technology for your process intensification .....</b>	<b>6</b>
<b>Sulzer SMV™ and Turbulent Mixers .....</b>	<b>7</b>
<b>Sulzer SMX™ Mixers .....</b>	<b>8</b>
<b>Sulzer Heat Exchangers and Reactors .....</b>	<b>9</b>
<b>Chemical Process Industry .....</b>	<b>10</b>
<b>Energy .....</b>	<b>11</b>
<b>Water &amp; Wastewater .....</b>	<b>12</b>
<b>Food Processing Industry .....</b>	<b>13</b>
<b>Oil, Gas &amp; Refinery .....</b>	<b>14</b>
<b>Polymer Production .....</b>	<b>15</b>
<b>Fiber Production .....</b>	<b>16</b>
<b>Plastics Processing .....</b>	<b>17</b>
<b>Disposable Mixers &amp; Cartridges .....</b>	<b>18</b>
<b>Our Capabilities: Development &amp; Technology .....</b>	<b>19</b>

**Sulzer mixers: Broadly imitated**

**...never duplicated**

### **Always a step ahead**

Since the early 1970's Sulzer Chemtech has pioneered static mixing to enable homogenization and dispersion of gases and liquids without resorting to moving parts. The ongoing development and innovation brought diversification in the area of heat and mass transfer, reaction technology, polymer production and plastics processing over a wide range of fluid properties and process conditions.

Today, we are the undisputed market and technology leader serving the global needs of our customers with the widest range of products and applications. Our solutions are backed by the experience of more than 70,000 references and the latest methods in development, client testing, engineering and fabrication to meet the processing challenges of our customers and create long term benefits.



*Innovative engineering  
and production*

### **What is the secret of the Sulzer mixers?**

- Decades of experience in design, manufacturing and applications
- Backed by unparalleled know-how in fluid dynamics
- Best R&D facilities in the industry
- Standardized and accurate design standards
- Customized customer testing units
- Widest range of mixer types, sizes and materials of construction
- Fit for any mixing requirement



### **What can our customers rely on?**

- Customized solutions
- Joint development work
- Proven design – proven components
- Execution of smallest and largest projects on time
- Troubleshooting and global service
- Improvement of process reliability, energy consumption and product quality
- Highest rates of return due to best mixing effect
- Competitive pricing

# Static mixing to your advantage

...70,000 references

**Static mixers are tubular internals of appropriate shape and strength to cause desired mixing and dispersion effects as the fluid flows around suitably arranged motionless mixer parts. The fluid flow is provided by pumping.**

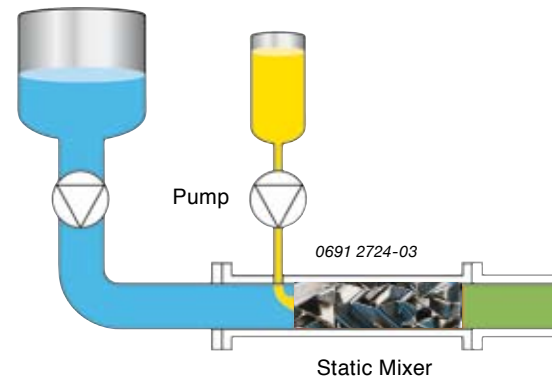
In practice, small volumes, low maintenance, simple installation and cleaning and excellent reliability characterize the static mixer.



Laminar mixing in the Sulzer SMX™ mixer shown with Laser Induced Fluorescence

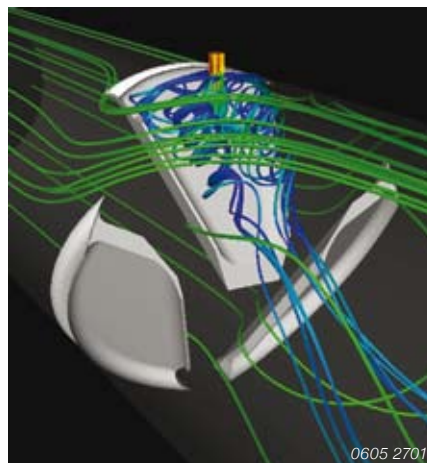
### Laminar mixing

Laminar mixing is achieved by repeated division, transposition and recombination of liquid flowing around a static mixer. The components to be mixed are spread into a large number of fine layers. A static mixer consists of several identical mixing elements. The more mixing elements, the finer the layers. The finer the layers, the better the homogeneity of the mixture.



### Turbulent mixing

Some turbulent mixing is observed even in an empty pipe. By installation of a static mixer, however, the distance required to achieve a good homogeneity is reduced by a factor 10 and more. A static mixer has one or several mixing elements generating eddies in the flow. Any kind of inhomogeneity will be dissipated by strong cross currents within the mixing elements and downstream.



Turbulent mixing with eddies in the CompaX™ mixer shown in a CFD simulation

# Leading technology for your process intensification



## Mixing

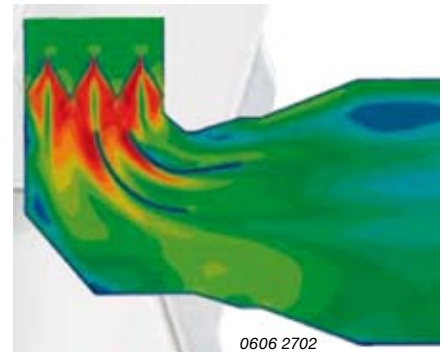
Blending of miscible components regardless of the volume, density, viscosity and properties of the media.



## Dispersing and Contacting

Dispersing two or more products for scrubbing processes, reactions, mass transfer.

Contacting of liquids with gases to create high mass transfer surface area and high rates of absorption, reaction, vaporization and condensation.



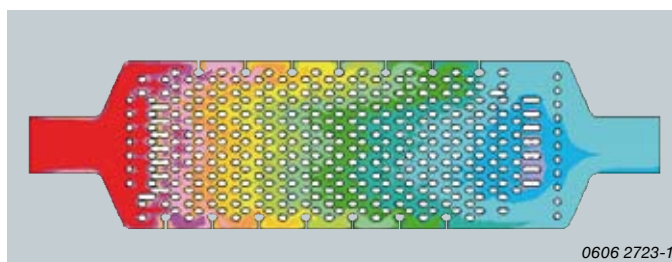
## Conditioning

Conditioning of process flows upstream of reactors and heat exchangers for increased efficiency.

## Heat Exchange and Reaction

Heat exchangers for controlled reactions, high conversion or gentle tempering of viscous media.

Reactions within a narrow residence time distribution and maximum possible driving force.



# Sulzer SMV™ and Turbulent Mixers

8840 5801

- Turbulent mixing, dispersing and contacting for mass transfer and reactions
- Mixing and homogenizing of liquids and gases of low viscosity
- Admixing low viscous additives



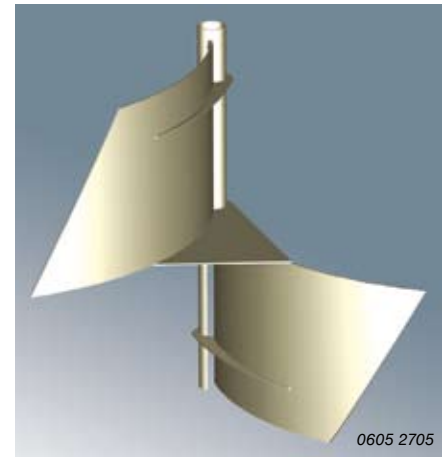
## SMV™

Turbulent mixing with highest mass transfer rate



## SMV™ Gas Mixer

Shortest mixing length



## Contour™ Gas Mixer

Optimized turbulent flow



## SMI

Prevents clogging



## CompaX™

Shortest space requirement



## KVM

Smallest pressure drop

# Sulzer SMX™ Mixers

0698 2734

- Laminar mixing
- Best handling of large viscosity difference
- Homogenization and dispersing of viscous liquids
- Blending melts and homogenizing fibers
- Injection molding and blowing agents



0606 2725

## SMX™

Gentle and efficient mixing of viscous products



0681 2040

## SMX™

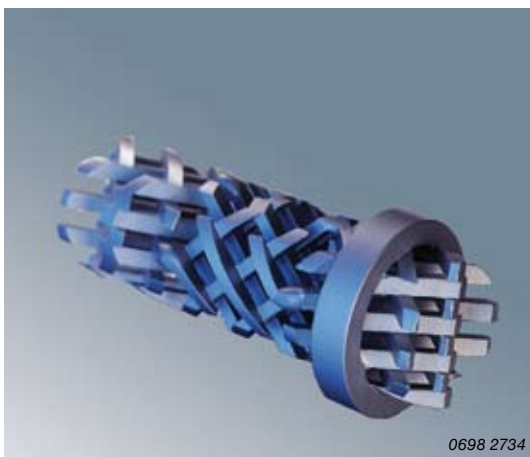
Achieves shortest mixing length



0604 2717-2

## Polyguard™

Handles sensitive products



0698 2734

## SMXS

Extreme mechanical strength



0612 7050-1

## Fiber Module

For temperature homogenization

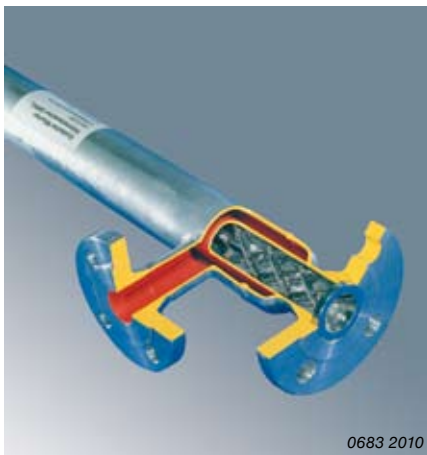
# Sulzer Heat Exchangers and Reactors

0604 2709

- Selective control of exothermic or endothermic reactions
- Narrow residence time distribution
- Gentle cooling and heating of temperature-sensitive viscous media
- Enhancement of heat transfer rates in heat exchanger tubes for viscous and temperature-sensitive products

## SMR™

Plug flow behavior with large heat exchange area for applications with demanding rheology



SMXL™ Mono Tube

## Heat Exchange

Enhanced heat transfer for highly viscous products



SMXL™ Multi Tube



# Chemical Process Industry

...over 15,000 references

4588 4059

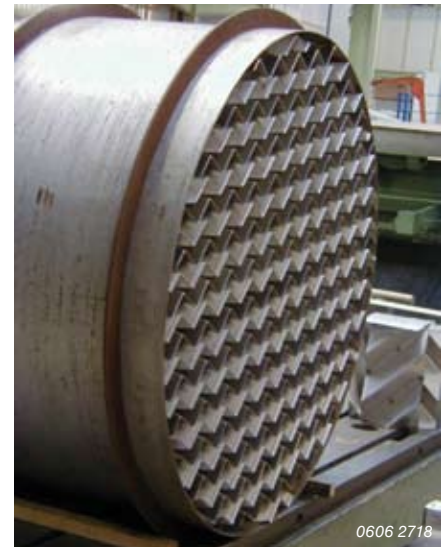
Thousands of references document the versatility of Sulzer mixers in the chemical process industry. The applications range from mixing of liquids at various viscosities, mixing including reaction, gas liquid contacting, mass transfer and absorption, gas mixing and liquid evaporation. In order to cope with corrosive chemicals the mixers are available in a wide range of materials.

### Customer benefits

Uniform and consistent process conditions in respect to

- Concentration
- Temperature
- Residence time distribution

- Consistent product quality
- High yield
- High selectivity for continuous reactions
- Low energy consumption
- Low volume of the mixer/reactor
- Low volume/hold up of the processed products
- Low maintenance cost (no moving parts)
- Easy start up and operation



0606 2718

SMV™ EDC reactor

### Main Applications

- Dilution of liquids
- In-line mixing of various additives
- Liquid and gas flow conditioning
- Dispersing of liquids
- Evaporation of liquids into gas streams
- Gas/liquid contacting
- Absorption of gases in liquids



0694 2720

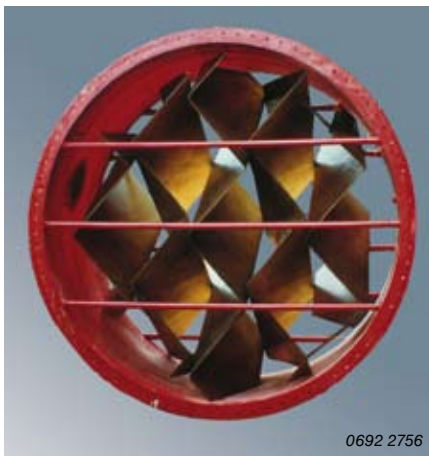
SMV™ Spray evaporator

Energy – DeNO<sub>x</sub>

...over 1,800 references

0606 2729

Sulzer mixers have enormous potential in energy technology, and their use is widespread. In gas treatment, small amounts of reactive agents are often added to high volume flows and distributed very uniformly within a short distance over the entire channel cross section. In other applications, it is necessary to uniformly distribute the concentration and temperature of a process feed upstream of a catalyst or to dissolve gases into liquids and to generate fine, uniform bubbles in insoluble liquids. Sulzer has the proven mixing technology and products for these growing processing technologies.

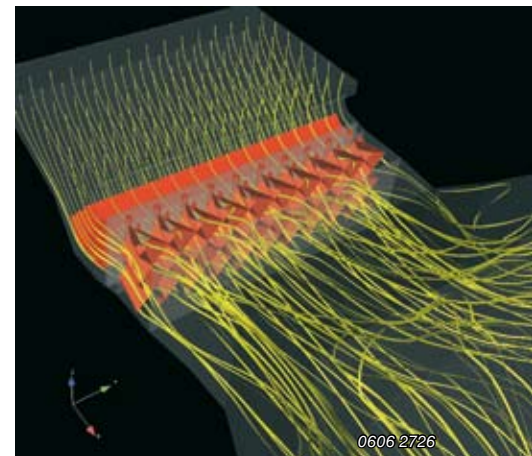


0692 2756

SMV™ gas mixer for flue gas treatment

#### SMV™ gas mixer for challenging space limitations

- Excellent mixing performance for shortest space requirements
- Fits any duct dimension
- Well suited for dosing small amounts of additive
- Low pressure drop



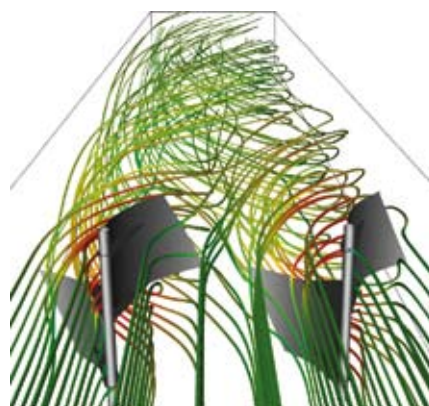
0606 2726

CFD simulation for a DeNO<sub>x</sub> application

#### Contour™ mixer for gas conditioning

The new Contour mixer provides effective large scale eddy mixing

- For any required gas conditioning task
- At lowest pressure drop in the industry



0606 2716

Ideal flow conditions in the Contour™ mixer

#### Main Applications

- Injecting ammonia into flue gas for NO<sub>x</sub> removal
- Gas conditioning
- Oil/water dispersions

**Water & Wastewater**

**...over 4,500 references**

0691 2724 02 / -3

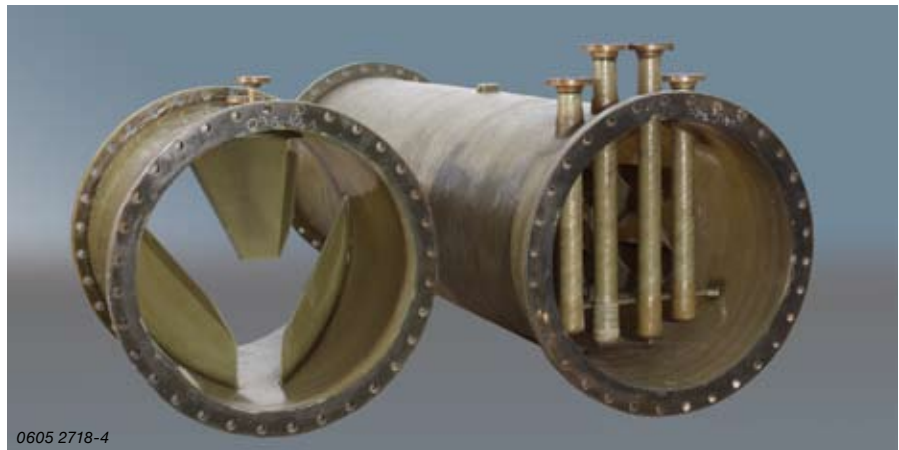
### Mixers for water/wastewater treatment

In the field of water and wastewater treatment, mixing and contacting are key unit operations. There is a fundamental influence on the performance of individual process stages or even on the results of the entire process itself. The ever increasing demands on water quality drive continuous improvement of the purification processes. This has led to an increasing number of installations of in-line static mixers for mixing and contacting operations in the water and wastewater sector.

The use of static mixers in the water/wastewater industry saves costs by reducing additive consumption.

### Customer advantages

- High specific exchange area leading to efficient mass transfer
- High utilization rate of the ozone gas
- Short installation length
- Low pressure drop
- Guaranteed absorption degree of the gas
- Steady absorption degree at turn-down and turn-up conditions



0605 2718-4

*CompaX™ and SMV™ mixers in FRP for seawater desalination*

### Main Applications

- Admixing of flocculent into water or sludge
- pH control or neutralization
- Oxygen enrichment of drinking water
- Ozonization of water
- Admixing of disinfectants
- Admixing of additives for the sea water treatment



0692 2735

*The SMF mixer in polypropylene for sludge treatment*

# Food Processing Industry

...over 4,000 references

Static mixers and heat exchangers have been used in the food industry for over 30 years.

Sulzer mixers offer an outstanding mixing performance combined with excellent cleaning and sterilization abilities, an essential requirement for continuous food processes. They are used in various branches in the food industry (e.g. dairy, sweets, beverage, ingredients, etc.).

Applications range from blending, dispersing, foaming, aerating, conditioning, heat exchange to various other operations in the liquid, gas and sometimes solid field.



*Gentle mixing of fruit into yoghurt*

### Static mixers for

- Easy cleaning and sterilization in place (CIP)
- Uniform and gentle product treatment
- Reproducible product quality
- Shorter process time

### Main Applications

- Mixing flavors and colors into creams, yoghurt, chocolate, etc.
- Desliming vegetable oils with phosphoric acid
- Homogenization of sweet masses
- Carbonization of beer with CO<sub>2</sub>

### Static mixer heat exchangers

The Sulzer mixer heat exchangers SMXL™ or SMR™ are well suited for cooling, heating or sterilization of food products.

- No dead zones
- Excellent in-line cleaning ability and sterilization
- Capability to process viscous fluids
- No sealing and wearing problems
- Low shear stress, gentle handling



*SMR™ for chocolate cooling*

### Main Applications

- Cooling of chocolate, creams or sweet masses
- Heating of dough or coffee extract
- Crystallization of caramel
- Sterilization of vegetable or fruit concentrates

# Oil, Gas & Refining

... over 3,000 references

0606 2715

There are numerous applications for static mixing units in the petroleum industry.

By using Sulzer mixers some widely recognized corrosion problems in oil refineries and gas plants can be significantly reduced. Sulzer Chemtech has the right solution for offshore platforms, for transporting oil, for the measurement of the water content of crude oil, for desuperheating purposes, for the desalination plant, for distillation units or for alkylation or catalytic processes. Our static mixers not only reduce operating costs, but also increase plant on-stream time. As a result, they are a sure demonstration that Sulzer Chemtech mixing and reaction technology pays off, whatever the application.



*SMV mixer PN 400  
for temperature  
homogenization*

0698 2712

*SMV mixer for LNG  
desuperheating in  
a regasification plant*

## Main Applications

- Desalting of crude oil
- Gas scrubbing for removal of sulphur compounds
- LNG desuperheating
- Blending of gasoline, diesel, lubricants, etc.
- Crude oil sampling



0605 2715-1

# Polymer Production

... over 300 references

0698 2719

Handling of highly viscous melt is often one of the key tasks in the polymer production industry. Sulzer has the right equipment and the necessary fundamental understanding of mixing phenomena to handle your application.

## Value creation for the polymer industry

- Customized solutions
- Customer testing and pilot work
  - e.g. in the Sulzer lab
- Scale-up know-how
- Broad expertise in process and equipment engineering

## Customer advantages

*Increased product quality through*

- Shortest possible residence time
- Reduced degradation
- Lowest residual volatile contents
- Precise heat transfer control
- Plug flow behavior

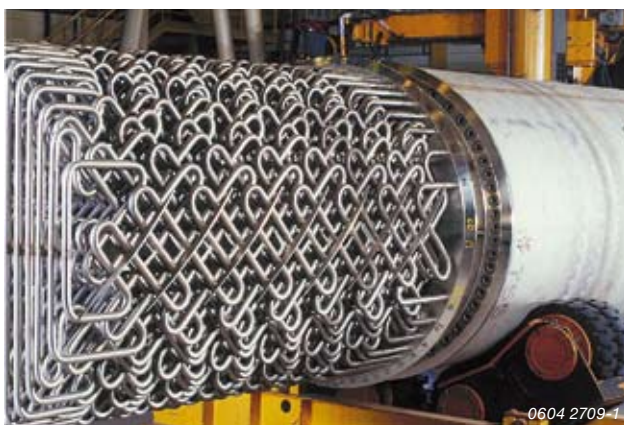
*Reduced costs through*

- Virtually no maintenance
- Very high polymer conversion
- Lowest energy consumption



SMR™ reactor for polystyrene

0605 2720-2



0604 2709-1

SMR™ bundle

## Main Applications

- Loop and plug flow reactors
- Removal of volatile components
- Heating and cooling of polymer melts
- Admixing of liquid additives or masterbatch

# Fiber Production

... over 2,200 references

Static mixers and coolers are used in fiber production to ensure optimal mixing, homogenization and cooling of the polymer melt (PET). This provides a basis for an economic production of man made fibers of consistently high quality.



0609 2715

SMX™  
melt homogenizer

## Melt homogenization

In spinning plants SMX™ mixers are installed prior to line splitting, at the spin position and in the spin packs to avoid fiber breakage.

## Admixing of additives

The SMX mixer handles great viscosity differences as well as dispersive mixing. The highly effective mixing characteristics prevent unnecessary over dosing of additives and result in substantial cost savings.

## Polymerization

Due to the narrow residence time distribution in a SMX™ tubular reactor, a spinning polymer is produced with a narrow molecular weight distribution and low content of by-products.

## Cooling / heating

In cooling applications the SMR™ structure achieves mixing, boosts the heat transfer and provides plug flow. Very low temperature driving force and low pressure drop operation without maldistribution or plugging are possible. In addition, the capital and operating cost of ancillary equipment like pumps is up to 25% lower than in the case of multitube heat exchangers filled with mixing elements.

## Main Applications

- Homogenization of melts
- Mixing of additives
- Cooling of polyester melt in direct spinning plants
- Gentle heat-up of spinning solutions
- Polymerization in a plug flow reactor



0690 2750

SMR™  
heat exchanger

# Plastics Processing

... over 15,000 references

0698274102

A perfectly homogenized melt is one of the most important requirements in achieving high quality polymer products.

Irregularities, such as color streaks, flow lines, uneven wall thickness, flow variations etc. lead to increased reject rates and increased production costs and are often the result of poor quality melt homogenization.

The Sulzer mixing head SMK-R is an efficient tool developed to provide consistent melt homogeneity in injection molding machines. For extrusion and blow molding applications, the Sulzer Melt Blender SMB-R is used to achieve the same results. These Sulzer mixers provide a larger processing window, allow higher throughputs and give improved product quality while ensuring that products are produced more economically.



0601 2702-2

SMK-R mixing head for injection molding

## The benefits for the extrusion process

- Consistent product quality
- Uniform wall thickness
- Elimination of flow lines
- Closer tolerances

SMB-R for extrusion



0698 2732-2

## The benefits for injection molding technology

- Reduced color costs
- Lower reject rates
- Faster cycle times
- Improved mixing of regrind
- Fast payback

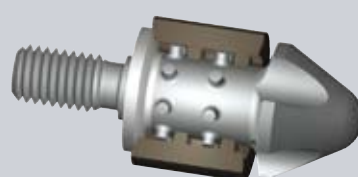
## Additional products



0604 2719-1

### Polyguard™

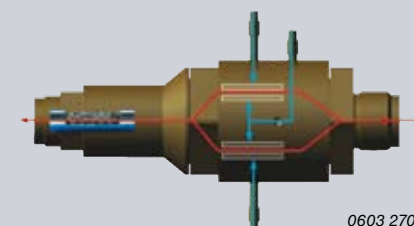
The mixer for PVC and rubber extrusion



0604 2716-1

### VIP™

The dynamic mixer with intermeshing pins



0603 2708

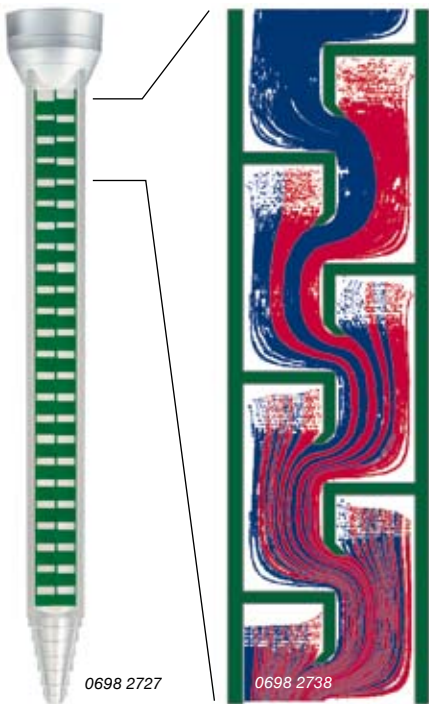
### Optifoam™

The technology for foamed plastics

# Disposable Mixers & Cartridges ... over 6,000 references

0605 2714

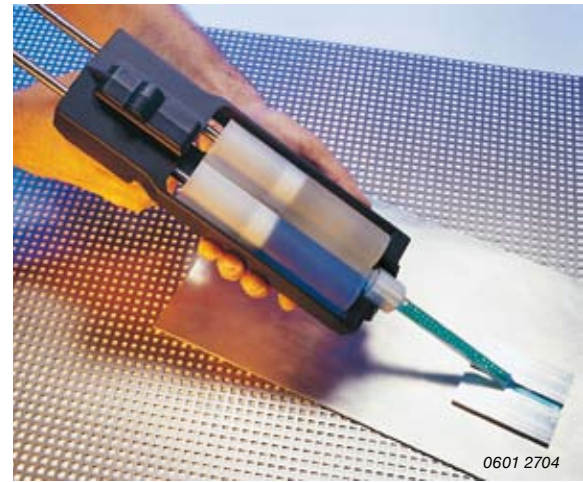
**Quadro™ Systems** is a leading manufacturer of disposable packaging and mixing solutions for two-component adhesives. Quadro Systems is located worldwide and has more than 10 years experience in the design and production of disposable mixers, cartridges, syringes and many other items used in the 2K-adhesive industry. Our success is based on leading technology and the ongoing high quality of our products as well as unsurpassed customer service.



## Sulzer Quadro™ Mixers

The Sulzer Quadro disposable mixer sets new standards for mixing reactive adhesives. Sulzer Quadro mixers are used for cartridge applications or for meter mix dispensing machines.

The unique mixing geometry of the Sulzer Quadro mixer makes it the disposable mixer with the lowest waste volumes and shortest overall length for a given pressure drop.



## Sulzer Quadro™ Cartridges

Quadro Systems offers a wide range of disposable 2K-cartridges for a variety of applications. Side-by-side cartridges as well as coaxial cartridges are available in volumes from 4 ml up to 825 ml and in volume ratios of 1:1, 2:1, 4:1 and 10:1.

## Main Applications

Disposable mixers and cartridges for:

- Reactive adhesives
- Chemical anchoring
- Meter mix dispensing machines
- Other customized solutions



## Our Capabilities: Development & Technology

0699 2707 02

Sulzer Chemtech offers a variety of pilot testing services at company headquarters in Winterthur, Switzerland. Whenever physical properties, phase behavior or product purities are not known to the extent required for reliable design, Sulzer Chemtech has the ability to perform test work tailored to the specific project requirement and customer objectives. The pilot installations are large enough to enable our experts to reliably scale-up the process to commercial size.

We apply our expertise, know-how and analytical skills to creating individual solutions, specially customized for your particular processing situation.

Pilot plants and test rigs for the following applications are available for customer testing:

- Reaction and devolatilization of polymers
- Admixing of additives into highly viscous melts
- Extrusion and foam injection molding with physical blowing agents
- Heat exchange for low and highly viscous products
- Dispersion of immiscible liquids and gas/liquid

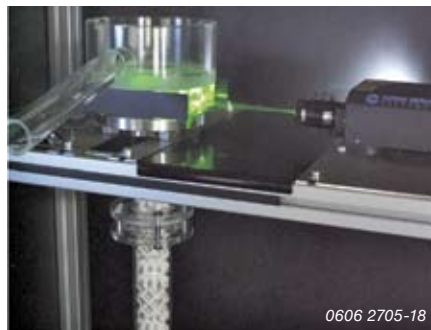
**Mixers are also available for testing at customer's sites.**



Epoxy cut

CFD

LIF



LIF system with laser visualizes the mixing capability of a SMX™ mixer

Pilot testing not only requires modern pilot plants, but also analytical methods to verify product quality. Sulzer Chemtech relies on CFD-supported process and product optimization and uses the Laser Induced Fluorescence (LIF) method for measuring mixer performance. The combination of CFD simulations and LIF measurements enables our engineers and scientists to reliably evaluate the homogeneity of the mixing process.



0606 2717



#### Headquarters

Sulzer Chemtech AG  
P.O. Box 65  
CH-8404 Winterthur, Switzerland  
Telephone +41 (0)52 262 67 20  
Fax +41 (0)52 262 00 69  
E-mail chemtech@sulzer.com  
Internet www.sulzerchemtech.com

#### North and South America

Sulzer Chemtech USA, Inc.  
4019 S. Jackson Street  
US-Tulsa, OK 74107  
Telephone +1 (918) 445-6614  
Fax +1 (918) 445-6670

#### Asia Pacific

Sulzer Chemtech Pte. Ltd.  
Regional Headquarters  
25 International Business Park  
#03-28 German Centre  
SG-60 99 16 Singapore  
Telephone +65 6863 75 60  
Fax +65 6861 15 16

Sulzer Chemtech Ltd, a member of the Sulzer Corporation, with headquarters in Winterthur, Switzerland, is active in the field of process engineering and employs some 1500 persons worldwide.

Sulzer Chemtech is represented in all important industrial countries and sets standards in the field of mass transfer and static mixing with its advanced and economical solutions.

The activity program comprises:

- Process components such as trays, structured and random packings, internals for separation columns and reaction technology
- Engineering services for separation and reaction technology such as optimizing energy consumption, plant optimization studies, pre-engineering for governmental approval, basic engineering
- Separation and purification of organic chemicals by means of crystallization and membranes
- Mixing and reaction technology with static mixers
- Tower field services

Distributed by:

--